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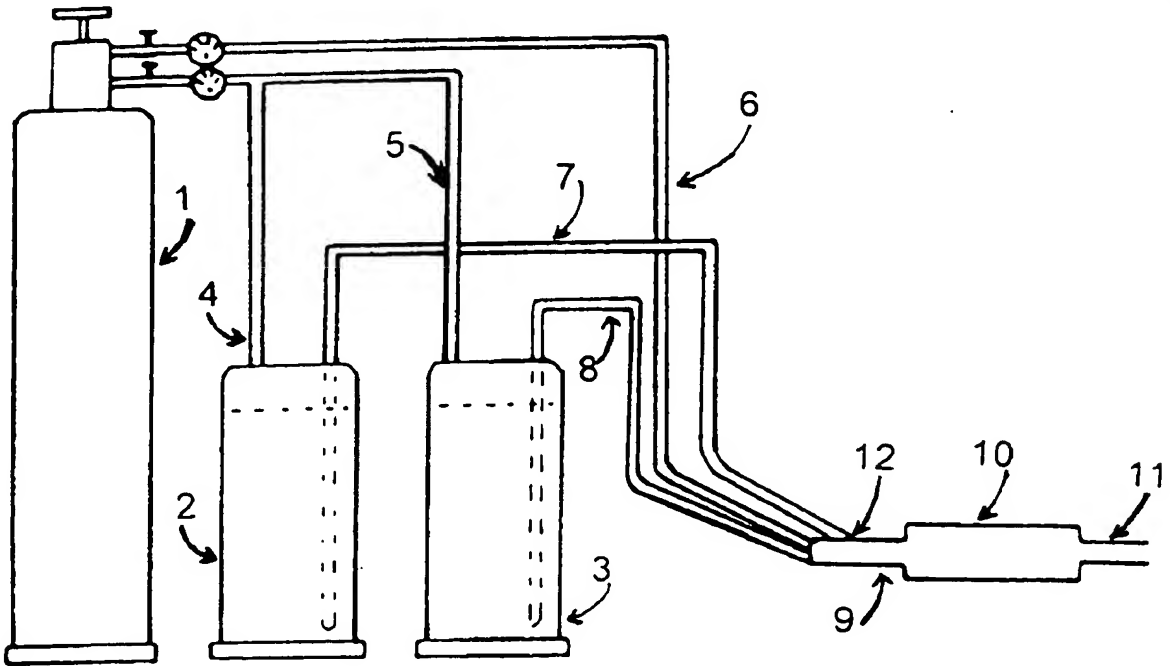
(54) Titre : PROCEDE ET APPAREIL DE FABRICATION DES MOUSSES D'UREE-FORMOL

(54) Title: PROCESS AND APPARATUS FOR MANUFACTURING UREA/FORMALDEHYDE FOAMS



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PROCESS AND APPARATUS FOR MANUFACTURING UREA/FORMALDEHYDE FOAMS

FIELD OF THE INVENTION

This invention relates to cellular plastic foams, and particularly to process and apparatus for manufacturing urea/formaldehyde foams. Such foams can be used, for example, in industry as oil absorbents.

BACKGROUND OF THE INVENTION

Urea/formaldehyde foams have been used as building insulation for decades. Different kinds fo UF foams, including modified UF foams, have been introduced since 1926. To the best of our knowledge, all UF foams commercially made in this world are resin coated or catalyst coated bubbles. According to National Bureau of Standards Technical Note 1210 :"Three major ingredients are used in the generation of foam : Urea-formaldehyde resin, a surfactant (generally called a foaming agent) which includes an acid catalyst or hardening agent, and air." "In the United States the foaming agent-catalyst mixture is in general pumped into the gun where compressed air mixes with it and mechanically expands it into foam consisting of small bubbles. The bubbles are then coated in the nozzle of the gun with the urea-formaldehyde resin which has been pumped through a separate line into the gun. The foam, consisting of resin coated bubbles, is forced out of the gun under pressure at which time it contains about 75 percent water by weight." This is resin coated bubbles------Most of UF foams are made according to this method.

"The technique for foam generation in the U.S. has also been used in Europe in other methods. As one example, both resin and foaming agent solutions are mixed through the expansion chamber of the gun. In another, the catalyst is added to the foam after initial expansion". This is catalyst coated bubbles.

We can say that there are other methods to make UF foams. Such as :" Using materials that react with the acid catalyst to form CO_2 gas, like those used in phenolic foam generation" or "Low-boiling liquids have also been used as expanding agents". These techniques are out of date and worthless.

Different kinds of apparatus have been introduced and commercially used too. Different apparatus may have different spraying nozzles, or may have different foaming chambers, but all of these apparatus have been designed and used to manufacture resin coated or catalyst coated foams.

There are several problems associated with these foams. One problem relates to the mechanical properties. These finished UF foams are usually brittle structures with very low compressive strength. In some cases, the foam was so poor that it collapsed after application or crumbled within weeks.

Another problem is shrinkage. There is shrinkage with these UF foams, and the shrinkage of these UF foams normally is between 3% to 8%, sometimes it can be 20% or even more.

Yet another problem associated with these foams is the density. The density of these foams is NOT less than 0.62 pound per cubic foot. This density is high for UF foams.

These traditional foams can pick up some oil. But it is not good enough to use them as oil absorbent.

SUMMARY OF THE INVENTION

The present invention has been provided to solve the aforesaid problems, and it is an object of the present invention to provide a process and apparatus for manufacturing well mixed, well solidified and well made UF foams.

It is another object of the present invention to provide a manufacturing process in which the mixing process is simultaneous with foaming process.

It is still another object of the present invention to provide a manufacturing process in which foaming process is also a very good mixing process.

It is a further object of the present invention to provide a manufacturing process in which the foaming process takes place at the same place where the mixing process takes.

It is a further object of the present invention to provide a manufacturing process in which expanding the mixture of urea-formaldehyde resin and foaming agent-catalyst is the main foaming process in the whole manufacturing process.

It is a further object of the present invention to provide a manufacturing process in which the solidifying process starts with the foaming and mixing process.

It is a further object of the present invention to provide a manufacturing process in which the solidifying process starts at the place where the foaming and mixing processes take place.

It is a further object of the present invention to provide an apparatus that can start the foaming, mixing and solidifying process at the same time.

It is a further object of the present invention to provide an apparatus that can start the foaming, mixing and solidifying process at the same place.

It is a further object of the present invention to provide an apparatus that can expand the mixture of urea-formaldehyde resin, air and foaming agent-catalyst into foam.

Three major ingredients are used in the generation of this novel foam : main composition which includes urea-formaldehyde resin and foaming agent, an acid catalyst and gas. These ingredients can also be urea-formaldehyde resin, a surfactant which includes an acid catalyst and gas. But traditional ingredients must be modified for this invention. Because in this invention, in a short time, the mixture of urea-formaldehyde resin, foaming agent and acid catalyst is still good to be used in a foaming process.

Broadly speaking, water-insoluble gases are suitable for this foaming purpose. It is economical to use compressed air, either from gas cylinders or compressors.

This novel foam has been used with excellent results as absorbent. One gram of this foam absorbs 63 gram diesel oil which is more than 70 ml.

This novel foam has many outstanding properties when compared to traditional foams. For instance, its density is 30% less than traditional foams, and its mechanical properties has been improved. It is half-flexible. Traditional foams are usually brittle structures. This foam is very stable too. We have made more than 100 cubic meters of this foam and we have not observed any shrinkage. The standards for shrinkage of traditional foams is usually 4%, and in fact it can be more than 20%.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention be better understood, preferred embodiments of it will now be described by way of examples, in reference of the following drawings in which:

FIGURE 1 is an elevational view of the first embodiment of this invention.

FIGURE 2 is an elevational view of the second embodiment of this invention. It is an apparatus of the earlier patent modified according to this invention.

FIGURE 3 is a perspective view of foaming chamber used in this invention.

FIGURE 4 is a perspective view of another foaming chamber used in this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, the apparatus includes a first container 1 which contains compressed air. A second container 2 and a third container 3 hold main composition and dilute acid catalyst separately. Container 2 and 3 can also hold urea-formaldehyde resin and surfactant which includes an acid catalyst too.

Container 3 communicates with container 1 through a conduit 5 and further communicates with a meeting chamber 9 through a conduit 8. Conduit 4 connects container 1 and 2 which communicates with chamber 9 through a conduit 7, and conduit 7 enter the chamber 9 through a spiral nozzle 12 which sprays ingredients into the chamber to help mixing process.

Main composition, acid catalyst and air meet at the meeting chamber 9 through conduits 7,8 and 6. The apparatus is operated by compressed air. When the ingredients enter the chamber 9, the pressure push them into foaming chamber 10 immediately. At foaming chamber 10, main composition and acid catalyst is mixed and foam is formed. Conduit 11 communicates with chamber 10 and discharges the foam.

Referring to FIGURE 2, the apparatus is modified from Bauer U.S. Pat. No.2860856. This apparatus is operated by compressed air supplied from the steel bottle 1, conduit 13 connects this bottle and container 14 which holds urea-formaldehyde resin, conduit 15 links bottle 1 to container 16 containing surfacant which includes acid catalyst. The container 16 is connected by a line 17 with a container 18 wherein the pre-foam is formed with the aid of compressed air introduced through the line 19.

The pre-foam thus prepared is led to a meeting chamber 20. The conduit 21 which leads the urea-formaldehyde resin from the container 14 to the meeting chanmber enters the meeting chamber through a spiral mixing nozzle 12. Spiral nozzle 12 sprays urea-formaldehyde resin into the meeting chamber to help mixing process. Urea-formaldehyde resin, air and pre-foam are forced into foaming chamber 10 immediately by pressure. At foaming chamber 10, pre-foam and urea-formaldehyde resin is mixed and foam is formed. Conduit 11 communicates with chamber 10 and discharges the foam.

FIGURE 3 shows one model of foaming chamber used in this

invention. It is a stirred foaming chamber. 23 is a stirrer. Air, urea-formaldehyde resin and surfactant which includes acid catalyst enter this chamber at 22 and foam exits at 24.

FIGURE 4 is another model of foaming chamber used in this invention. It is a beads-packed foaming chamber. This chamber is filled with glass beads 25. Main composition, air and acid catalyst enter this chamber at 26 and foam exits at 27.

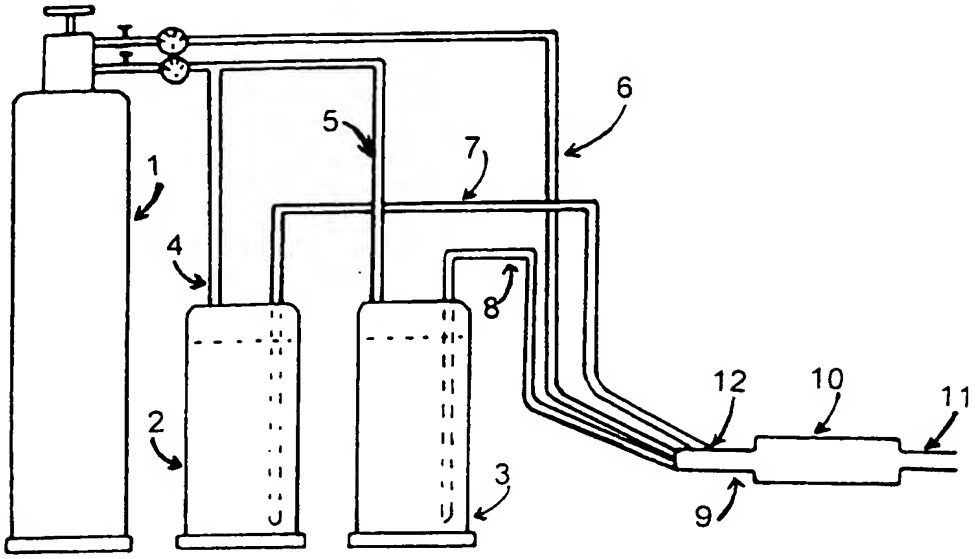

FIGURE 1

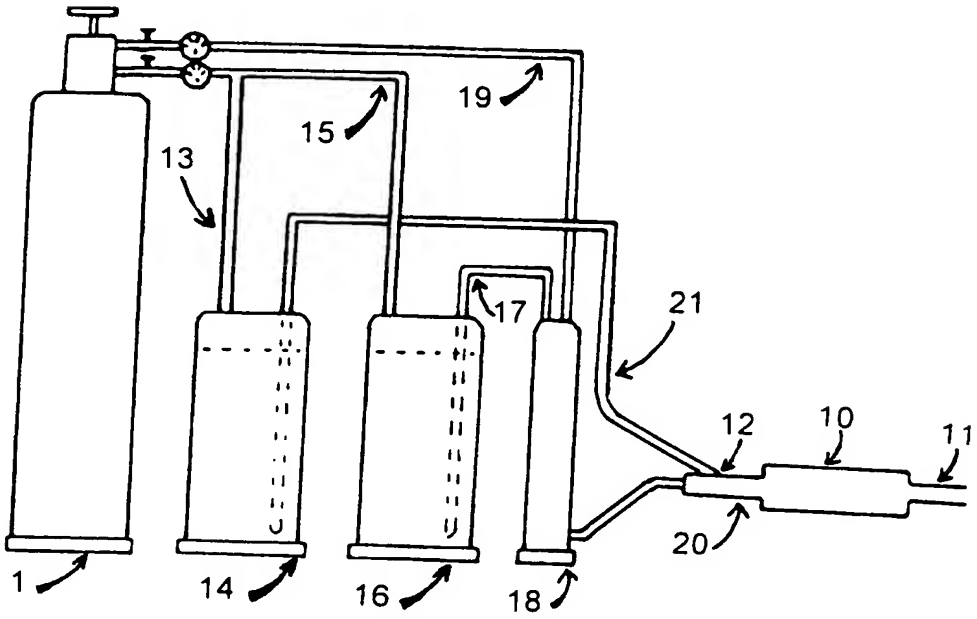

FIGURE 2

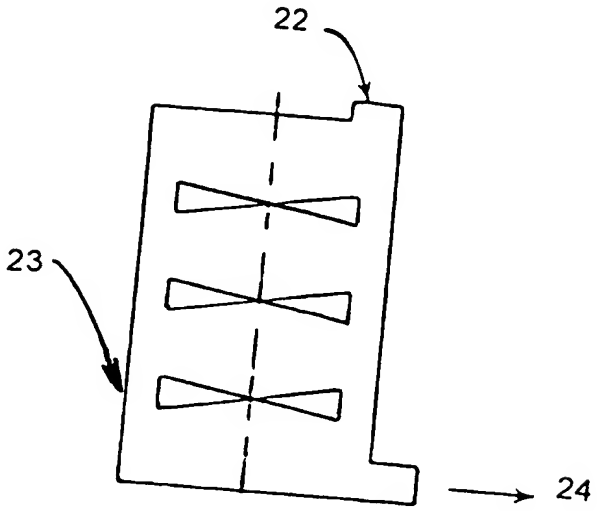

FIGURE 3

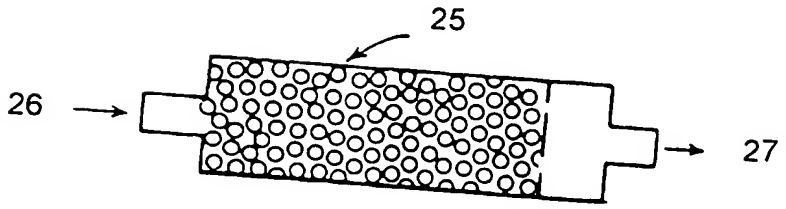

FIGURE 4